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COMPARATIVE SENSITIVITY OF TETRYL AND OF RDX/WAX MIXTURES AS BOOSTER EXPLOSIVES

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COMPARATIVE SENSITIVITY OF TETRYL AND OF RDX/WAX MIXTURES AS BOOSTER EXPLOSIVES

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ABSTRACT: The sensitivity of tetryl with or without a small amount of calcium stearate and graphite is compared to that of RDX/Wax mixtures 96/4, 94/6, and 92/8 when used as the booster explosive. The initiator was separated from the booster by a steel barrier, by an air gap, and by a steel barrier followed by an air gap. Design tests of the reliability with which a fuze system would initiate a tetryl booster could be made using the less sensitive RDX/Wax mixtures. Knowledge of the comparative sensitivity of these explosives could be used to predict the performance with the more sensitive tetryl. It is believed that this could be done with a smaller number of trials than would be required to test directly with tetryl.

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COMPARATIVE SENSITIVITY OF TETRYL AND OF RDX/WAX MIXTURES AS BOOSTER EXPLOSIVES

Introduction

1. The evaluation of an explosive train design requires an estimate of the reliability of that design in transmitting detonation from the initiating element to the lead or booster in the armed position. An estimate is also required concerning the degree of safety afforded by the device in the unarmed position. The desired reliability is high. The allowed number of failures under operating conditions is a fraction of one percent. A corresponding statement is true of the safety of the unarmed fuze. In this case the probability of having an explosion when the fuze is in the unarmed position must be very small. In order to investigate the reliability of a fuze in which the expected number of failures is of the order of one in a thousand would require at least a thousand trials if the fuze were tested without modification.

2. It is possible to avoid the need for such a prohibitive number of shots if the test is made under conditions more severe than those existing in the fuze which is being tested. This must be done in such a way that the results of the more severe test can be used to estimate the probabilities associated with the actual fuze design. If, for example, the design involved an air gap, tests of the reliability could be made of the system when the air gap was increased to a point where the failures become twenty to thirty percent. If this is done for several sizes of gap the probability of failure can be plotted as a function of the gap distance and the curve extrapolated to the value for the design under test. There is some danger in this method, however, since it is known that decreasing the air gap beyond a certain value may actually decrease the effectiveness of the fuze, reference (a). Rather than vary the inert parts of the system a change in the explosive elements used could be made. This report gives the results of an experiment which was designed to determine the effect of a change in the sensitivity of the booster explosive. The object of the experiment was to determine the relative sensitivity of certain RDX/Wax mixtures as compared with tetryl. The expectation is that if one wished to estimate the performance of a fuze which used tetryl as the booster explosive he would determine the percent fires obtained when the less sensitive mixture was substituted for the tetryl. A knowledge of the relative sensitivity of the two explosives could then be used to obtain the required estimate of the performance of the fuze.

Experimental Method

3. The results of tests with five explosives are given in the present report. Two varieties of tetryl are included. The first of these is tetryl without any additive substance. The second is tetryl as used by the army which contains a small percentage of graphite and calcium stearate. The other three explosives were mixtures of RDX with wax. The mixtures used were 96/4, 94/6, and 92/8.

4. These explosives were press loaded into wood blocks at a pressure of five thousand pounds per square inch. The explosive column was one half inch in diameter and one half inch long. Wooden pieces were used since they probably give about the same degree of confinement as would be furnished by more explosive. Thus, a full size booster could be approximated by a smaller amount of explosive. The initiator used in these experiments was one which was specially made using inert parts of the initiator, Mk 124. The explosive load was 120 mg of lead azide and 60 mg of PETN. The PETN base charge was pressed at ten thousand pounds per square inch. The azide flash charge was pressed at four thousand pounds per square inch.

5. Four tests were run with each booster explosive. The Bruceton up-and-down method was used. In the first test the booster explosive was separated from the initiator by only a barrier of cold rolled steel. In the second, there was no barrier, but an air gap separated the initiator and booster. This air gap was cylindrical with a diameter of 0.20 inches. Its length was varied to obtain fifty percent initiation of the booster. In the other two tests both a metal barrier and an air gap were used. In one case the metal barrier was kept constant at a thickness of 0.016 inches. In the other the length of the air column was fixed at an eighth of an inch. Figure 1 shows the experimental setup when both barrier and air gap were used. The arrangement was the same for the first two parts of the experiment except that the air gap or the barrier was omitted.

Results

6. The results obtained in the test using only an air gap between the initiator and the booster were somewhat erratic. A few failures were observed for much smaller gaps than would be consistent with the rest of the data. These failures were not considered in the calculations. Omitting these few failures in this test the mean and standard deviation were computed for each test with each booster explosive. For the purpose of these tests the differences in the estimates obtained for the

REFERENCES

(a) Ordnance Board Proceeding No. 30870 with enclosure, dated 15 April 1945 (British)

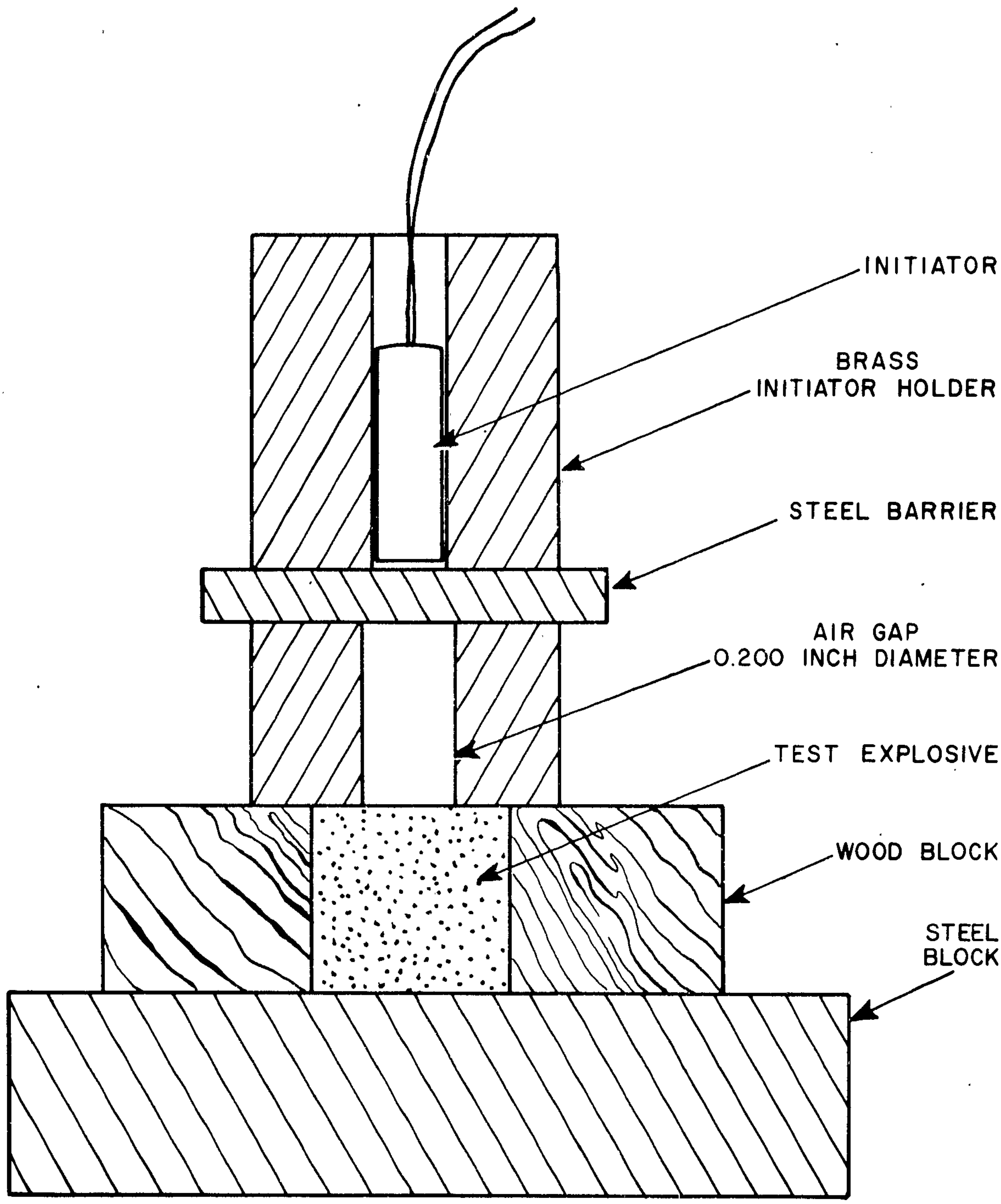

FIG. 1 EXPERIMENTAL ARRANGEMENT

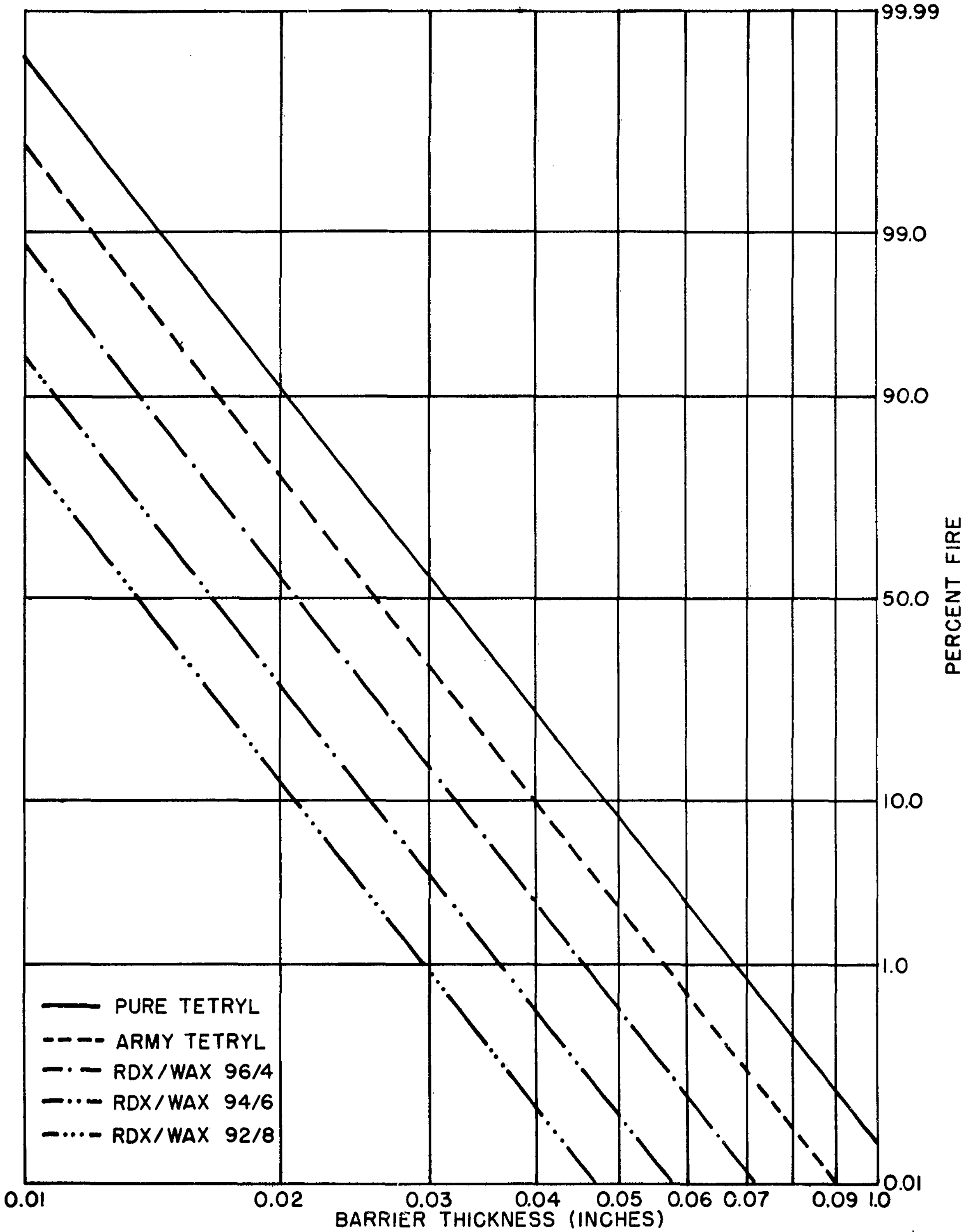

FIG. 2

COMPARATIVE SENSITIVITY OF BOOSTER EXPLOSIVES
BARRIER ONLY

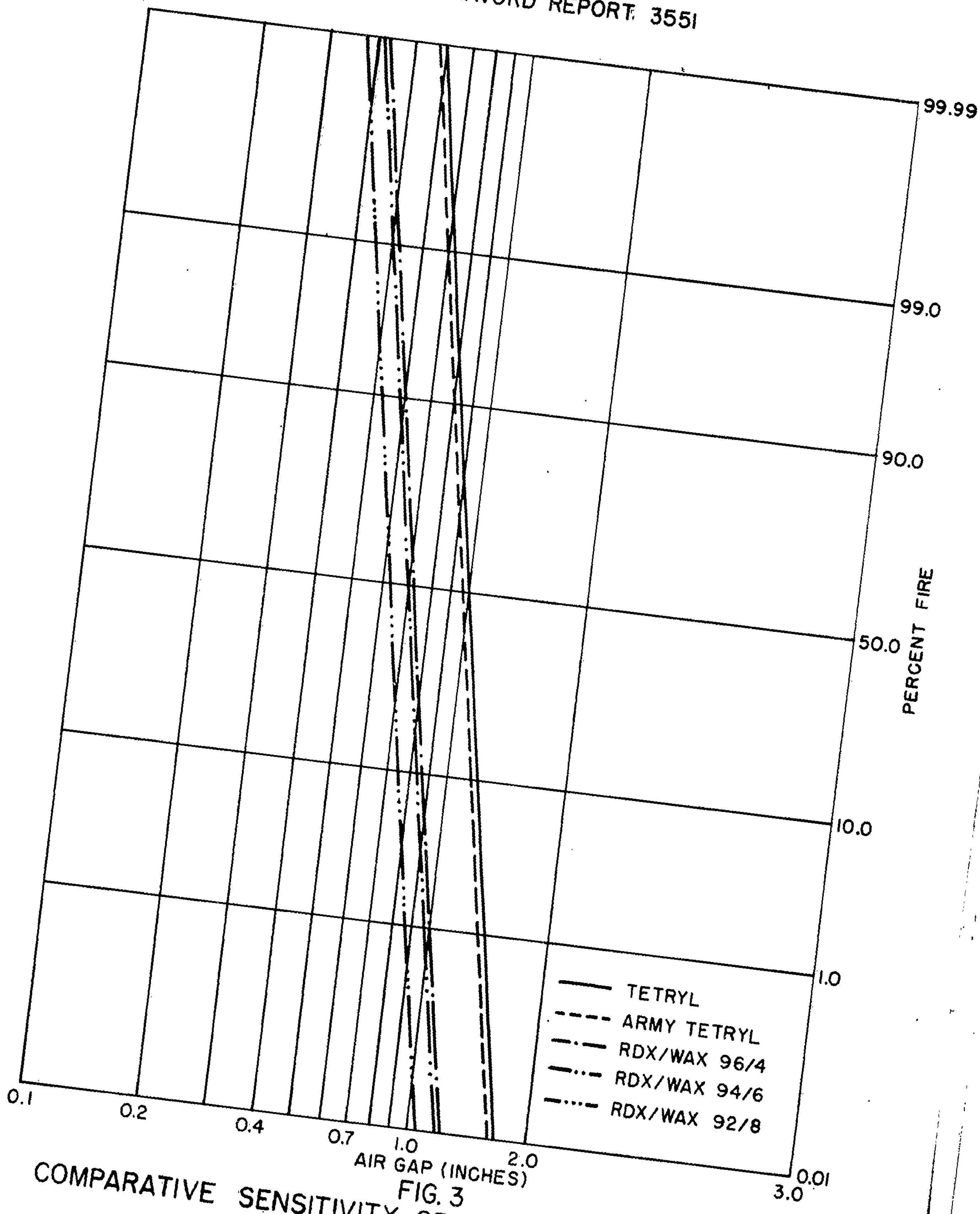

FIG. 3
COMPARATIVE SENSITIVITY OF BOOSTER EXPLOSIVES
AIR GAP ONLY

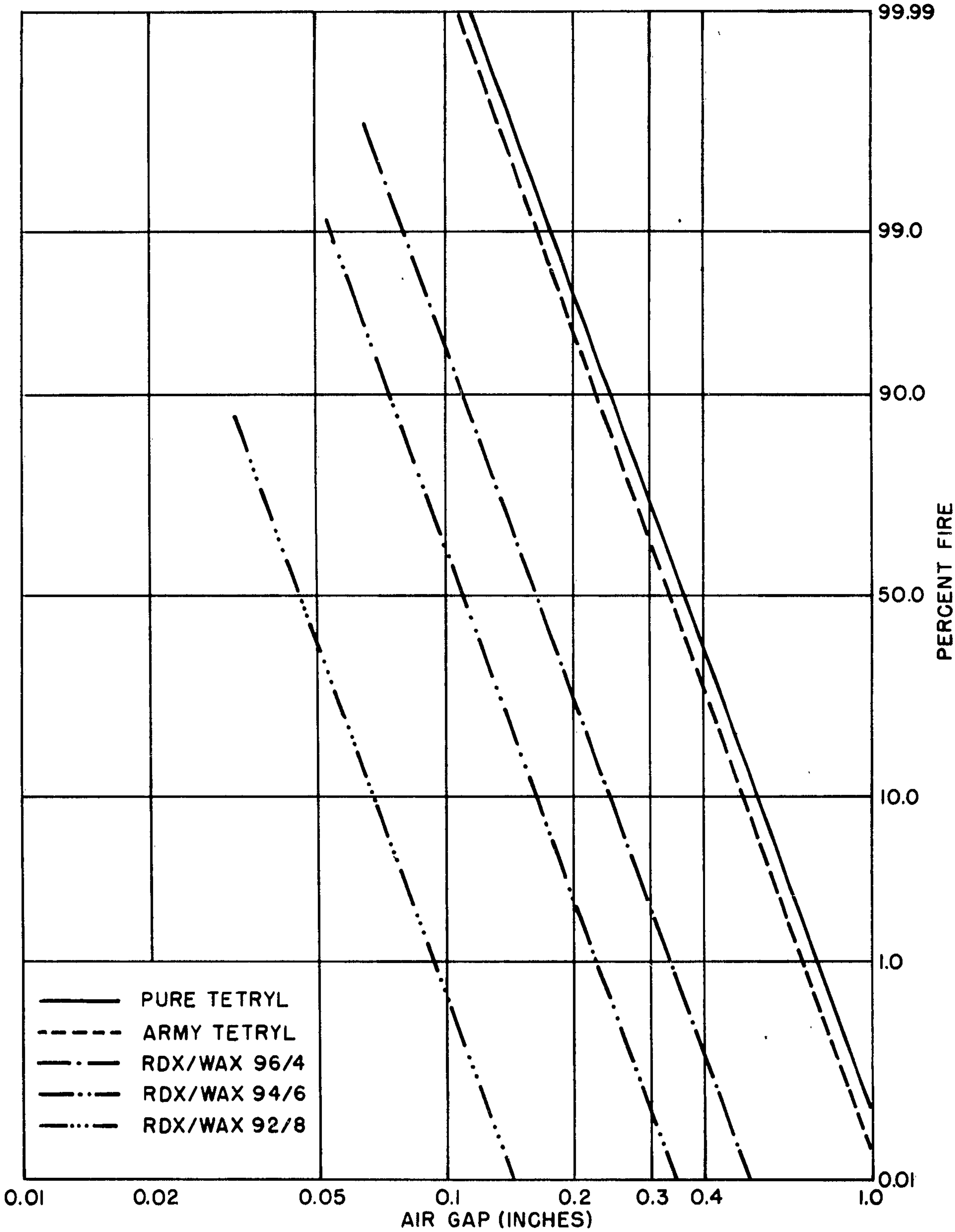

FIG. 4
RELATIVE SENSITIVITY OF BOOSTER EXPLOSIVES
0.016-INCH BARRIER AND AIR GAP

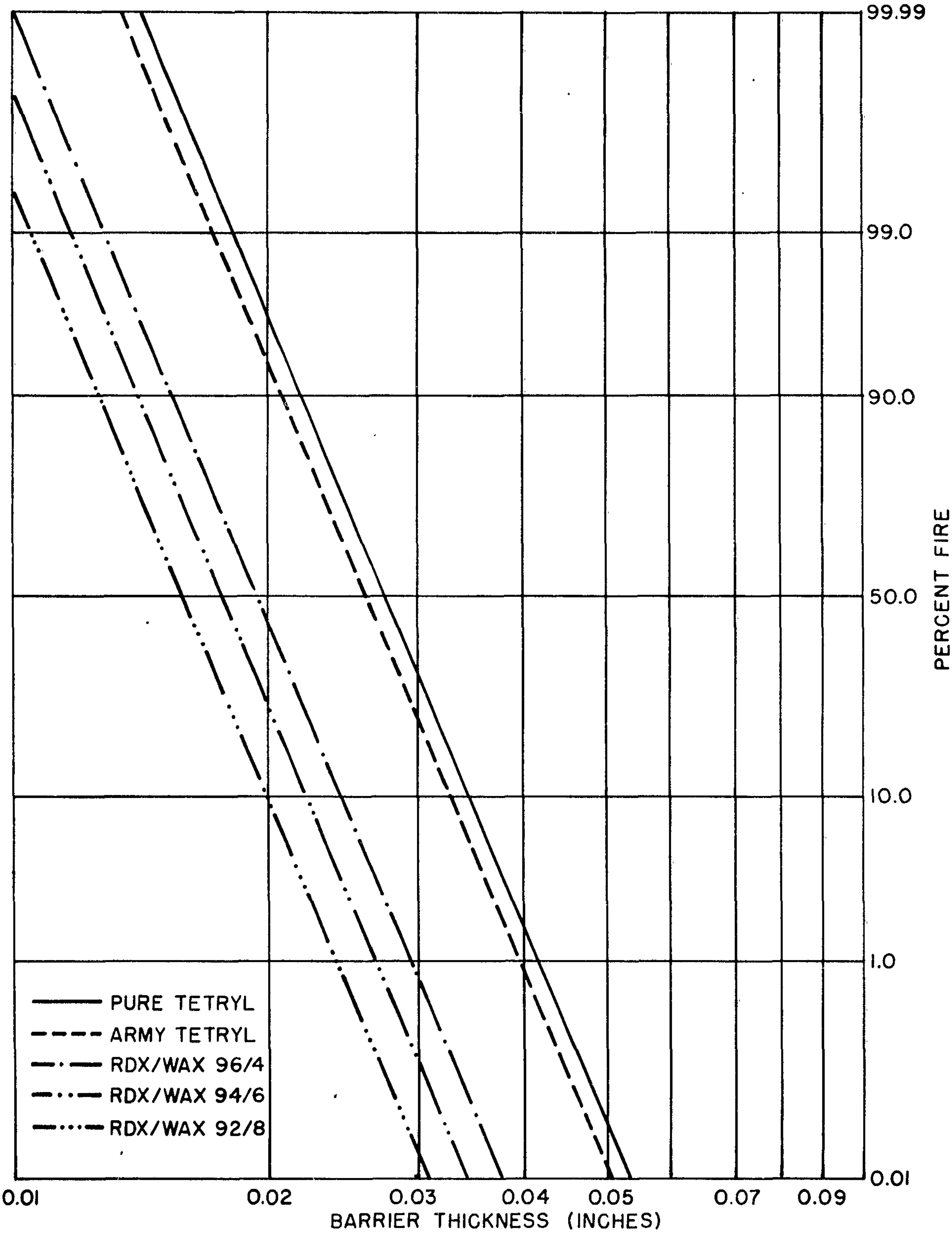

FIG. 5
RELATIVE SENSITIVITY OF BOOSTER EXPLOSIVES
BARRIER AND 0.125 INCH AIR GAP